The Consequences of the COVID-19 Pandemic on Smoking Behaviour: Evidence from the English Longitudinal Study of Ageing

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Abstract

Introduction

Smoking is a risk factor for progression of COVID-19, with smokers having higher odds of COVID-19 progression than never-smokers. This study presents novel findings on the effect of the COVID-19 pandemic on smoking behaviour in older adults.

Methods

Panel data were obtained from the English Longitudinal Study of Ageing ($N = 60160$, 12% smokers, 55% women, 62% married, mean age = 67 years, 23% employed). Fixed effect regression models were used to estimate the extent to which the COVID-19 pandemic affected smoking behaviour. A separate model was estimated for men, women, employed, and retired.

Results

The findings suggest a significant and positive effect of the COVID-19 pandemic on smoking behaviour ($\beta = 0.024; p < 0.001$). The estimated effects were stronger for men and for the sample of individuals reporting being employed.

Conclusions

In this study, I provide robust evidence of the effect of the COVID-19 pandemic on smoking behaviour using the English Longitudinal Study of Ageing. This large and representative dataset is uniquely suited for the analysis. I find evidence that the proportion of smokers has increased significantly as a result of the COVID-19 pandemic.

Implications

In the UK, the proportion of smokers increased significantly as a consequence of the COVID-19 pandemic. These findings suggest that smoking behaviour may have been used as a mechanism to cope with depression, stress, and anxiety due to the COVID-19 outbreak. To the extent to which

smoking behaviour has been used as a coping mechanism to deal with job-related issues, targeted policy action to provide financial stability to those in worse economic situations may be have beneficial effects on smoking behaviour.

Keywords: COVID-19, pandemic, smoking behaviour, ELSA.

1. Introduction

Coronavirus disease 2019 (COVID-19), is a contagious disease caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). The first known case was identified in Wuhan, China, in December 2019. The disease has since spread worldwide, leading to an ongoing pandemic. Due to the highly transmissible nature of COVID-19, a number of non-pharmaceutical interventions (encompassing stay-at-home orders, curfews, quarantines, and similar societal restrictions) have been implemented in numerous countries and territories around the world. By April 2020, about half the world's population was under some form of lockdown, with more than 3.9 billion people in more than 90 countries or territories having been asked or ordered to stay at home by their governments.

The aim of this study is to evaluate whether, and the extent to which, the COVID-19 pandemic had an effect on smoking behaviour in older adults. The outcome of this study is of particular importance not only because older adults are extremely vulnerable to the pandemic, but also because older smokers older smokers are more likely to have a longer duration of smoking habit, and report lower intention, and fewer attempts to quit **([1]** - **[4]**).

The answer to this question is not obvious as, conceptually, one may expect both a positive and negative effect of the pandemic on smoking behaviour. On the one hand, one may expect a reduction in smoking behaviour as a consequence of the pandemic, as there is well-established evidence suggesting that smokers are at higher risk of developing severe COVID-19 outcomes and death **([5]**-**[14]**). Additionally, the World Health Organisation (WHO) has also highlighted smokers' hand-to-mouth action, smoking-induced lung disease, and the sharing of tobacco products such as water pipes, as factors which may increase a smoker's vulnerability to SARS-CoV-2 infection and development of COVID-19 (**[15]**).

On the other hand, however, a positive relationship may also be observed if individuals have used smoking behaviour as a coping mechanism for depression, stress, and anxiety related to the COVID-19 outbreak. Indeed, several studies show that the implementation of restrictive measures to contain the spread of the virus had a strong negative impact on the mental health of the population (**[16]** - **[19]**).

Most likely, the two effects are not mutually exclusive but, rather, are at play simultaneously and, thus, whether the COVID-19 pandemic had an effect on smoking behaviour remains, ultimately, an open empirical question that is tackled in this paper.

2. Methods

Study Cohort

This study employs data from the English Longitudinal Study of Ageing (ELSA). The ELSA is a large-scale longitudinal panel study of people aged 50 and over, and their partners, living in private households in England (**[20]-[21]**). The initial sample was drawn from households that had previously responded to the Health Survey for England (HSE) in 1998, 1999 or 2001. To ensure that, in a given wave, the study remained representative of those aged 50 and over, new cohorts were added at wave 3, and wave 4. Every two years, the sample has been interviewed to measure changes in their health status, in their economic conditions, and in their social circumstances. As a consequence of the COVID-19 outbreak, in June 2020, an additional wave has been collected to investigate the extent to which the pandemic has affected the lives of study participants. After pooling together the ten waves and excluding the missing values on the variables used in the analysis, the final study sample size was 60160 observations.

Smoking status

The dependent variable of this study is a binary indicator for whether the individual reports being, currently, a smoker. Specifically, this was assessed with the question "*Do you smoke cigarettes at all nowadays?"* with the response options (1) Yes, (2) No, (3) Not Applicable. For our analysis, participants answering (1) were defined as "current smokers." The study did not test for differences between different intensities of smoking.

Covariates

A number of covariates are included in the analysis. Age was measured in years and was entered as both a continuous variable and as a quadratic term to account for the potential non-linear influence of age on smoking behaviour. Gender was coded as binary (male/female). Education was coded as binary, taking the value of one for participants who reported having achieved higher education. Marital status was entered as a binary variable (married vs divorced, separated, widowed, never married). Employment status was coded as one if individuals reported being

current in work. Household wealth was measured using the log-yearly equivalised disposable real household income deflated using the Consumer Price Index with baseline 2005 = 100. Individuals were classified as drinkers if consuming alcohol 5/7 days per week. Finally, the analysis also includes binary variables for individuals diagnosed with type-2 diabetes and hypertension, to account for the potential influence of the pre-existing medical condition on both smoking behaviour and COVID-19 related attitudes.

Statistical Analysis

Since the entire population has been exposed to the COVID-19 pandemic, the analysis is based on a before-after estimator, which compares the smoking before and after the COVID-19 outbreak. A similar approach was used by (**[16]**, **[22]**). In practice, the before-after estimator is carried out by estimating the following model:

$$S_{it} = \beta COVID19_{it} + X'_{it}\gamma + a_i + \mu_t + \varepsilon_{it}; \quad (1)$$

where S_{it} is the outcome of interest, namely a binary variable taking the value one if individual i at time t reports being a smoker. $COVID19_{it}$ is an indicator variable that takes the value 1 for individuals exposed to the COVID-19 pandemic, that is, it takes the value of one for all individuals at wave ten, and zero otherwise. β is the main parameter of interest which measures the effect of the pandemic on smoking behaviour. X'_{it} is a vector of participants' characteristics described above. As shown by Equation (1), the richness of the data allows strengthen the validity of the approach by including *(a)* individual-specific fixed effects, denoted a_i, to account for unobservable characteristics that do not vary with time and *(b)* year fixed effects, denoted μ_t, to control for time-varying factors that might affect the outcome of interest, such as population-level composition of older adults and inflation/cost of living. Finally ε_{it} is an independent and identically distributed error term. All analysis was undertaken on complete cases using STATA 15.

3. Results

The characteristics of the sample of interest are summarised in Table 1. Of the sample, 12% percent report being smokers, smoking an average of about 13 cigarettes per day. The rest of the Table

reports that the average age in the sample as 67 years. A total of 55 percent of the sample are women and 62 percent were married. The proportion of participants reporting having obtained higher education and being employed are, respectively, 16 and 23 percent. Of the sample, 26 percent report being drinkers, and 7 and 28 percent of the sample report being diagnosed with type-2 diabetes and hypertension, respectively. Finally, the mean (log-equivalised) household income is reported as 5.63.

Effect of the COVID-19 pandemic on Smoking Behaviour

I first begin this section by reporting the effect of the COVID-19 pandemic on smoking behaviour, via a graph. Specifically, Figure 1 shows that the proportion of smokers in the sample has been declining over time, starting from an average value of 18 percent in 2002, and reaching a value of around five percent in 2018. However, following the COVID-19 outbreak, the proportion of smokers rises to about eight percent.

Next, I report the results of the multivariate regression in Table 2. Column (1) reports the effect of the COVID-19 pandemic on smoking behaviour for the full sample. The estimated coefficient is 0.024, and is significant at the 1 percent level. The estimated coefficient implies that six months after the start of the pandemic the proportion of individuals reporting being a smoker has increased by 2.4 percent. In Columns (2) and (3), I split the sample by gender. The results show that the sample of men is driving the observed results. Specifically, six months into the pandemic, the proportion of men (women) who report being a smoker increased by 4.1 (1.2) percent. In Column (4) and (5), I further split the sample by labour market status and compare individuals who were employed with those retired before the pandemic. The Table reports that the estimated effects were significantly stronger for the sample of individuals who were employed before the pandemic. For this sample, the proportion of smokers increased by 5.2 percent.

4. Discussion

In this study, I provide robust evidence of the effect of the COVID-19 pandemic on smoking behaviour using the English Longitudinal Study of Ageing. This large and representative dataset is uniquely suited for the analysis. Using a multivariate regression model which accounts for individuals and time fixed effects, I find evidence that the proportion of smokers has increased significantly as a result of the COVID-19 pandemic. The findings of this study echo the results of Lee et al. 2021 (**[22]**) which, using the Nielsen National Consumer Panel (a longitudinal household cohort that collects

retail and e-commerce purchase data in the US), find that tobacco sales increased 13 percent during the COVID-19 pandemic compared with the same period in the year prior.

These findings can be interpreted as providing evidence that, indeed, smoking behaviour may have been used as a coping mechanism to deal with depression, stress, and anxiety resulting from the pandemic. To further investigate this hypothesis, in Figure 2 I plot the proportion of study participants reporting being depressed over time. The figure confirms that a significant increase in the proportion of individuals who report being depressed is a consequence of the pandemic. Notably, this finding is consistent with literature from the 2003 outbreak of severe acute respiratory syndrome (SARS), which reports a significant increase in emotional distress associated with quarantine and fear of contagion (**[23]**- **[27])**.

By means of a heterogeneity analysis I show that the observed effects are stronger for the sample of men, and for the sample of individuals who, before the pandemic, were employed. These results are consistent with recent findings in the literature suggesting that individuals in the labour market experienced stronger effects concerning the COVID-19 pandemic (**[28]**, **[29]**).

The main strength of this study is that the longitudinal nature of the data allows to explicitly account for individuals' unobserved heterogeneity, which is often regarded as the main cause of potential omitted variable bias.

The study presents two key limitations. Firstly, the data only allow to estimate the overall effect of the COVID-19 pandemic on smoking behaviour but does not allow to distinguish between the effect of its specific component, including fear of contracting the virus, lockdown and other non-pharmaceutical interventions, depression, stress, and anxiety levels. Secondly, in recent years there have been other global respiratory outbreaks (e.g., H1N1, SARS) which are not analysed in the study. However, the COVID-19 pandemic is likely to have had a much more significant global impact. This is confirmed in Figure 1, which shows that the other respiratory outbreaks do not appear to have had an impact on the smoking status trend.

In conclusion, in the UK, the proportion of smokers has increased significantly as a consequence of the COVID-19 pandemic. Concerning the extent to which smoking behaviour has been used as a coping mechanism to deal with job-related stress, targeted policy action to provide financial stability to those in worse economic situations may have beneficial effects on smoking behaviour.

Funding: The English Longitudinal Study of Ageing is funded by the National Institute on Aging (Grant: RO1AG7644) and by a consortium of UK government departments coordinated by the Economic and Social Research Council. O.A. is further funded by the National Institute for Health Research (PDF-2018-11-ST2-020). The funders had no role in the design or preparation of this paper.

Declaration of Interest: None

Data availability statement: All data used to prepare this paper are available at: https://ukdataservice.ac.uk/

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Figure 1: Effect of the COVID-19 Pandemic on Smoking Behaviour - Graphical Evidence

Source: English Longitudinal Study of Ageing (ELSA), Wave 1-10.

Notes: The Figure shows the evolution of the proportion of smokers over the period of interest.

Figure 2: Effect of the COVID-19 Pandemic on Depression - Graphical Evidence

Source: English Longitudinal Study of Ageing (ELSA), Wave 1-10.

Notes: The Figure shows the evolution of the proportion of individuals reporting being depressed over the period of interest.

Table 1: Summary Statistics

		95 % Confidence Interval	
	Mean/ Percentages	**Lower Limit**	**Upper Limit**
Smoker	12.24%	12.03%	12.45%
Number of Cigarettes	13.61	4.6	22.62
Participants Characteristics:			
Years of Age	66.92	57.13	76.71
Female	55.03%	54.72%	55.35%
Higher Education	15.98%	15.75%	16.21%
Married	62.40%	62.10%	62.71%
Employed	23.25%	22.99%	23.52%
Log of Household Income	5.63	4.93	6.33
Drinker	26.10%	2580.00%	26.41%
Type-2 Diabetes	7.03%	6.87%	7.19%
Hypertension	28.20%	27.92%	28.40%
Observations	60160		

Source: English Longitudinal Study of Ageing (ELSA), Wave 1-10.

Notes: The Table reports summary statistics of the variables of interest. For binary variables the table reports percentages, while for continuous variables the table reports the mean.

Table 2: Effect of COVID-19 Pandemic on Smoking Behaviour

	(1)	(2)	(3)	(4)	(5)
	Full-Sample	**Men**	**Women**	**Employed**	**Retired**
COVID-19	0.024***	0.041***	0.012**	0.052***	0.017***
	(0.004)	(0.007)	(0.005)	(0.011)	(0.004)
Socioeconomic Attributes:					
Years of Age	-0.020***	-0.024***	-0.017***	-0.025***	-0.019***
	(0.002)	(0.004)	(0.003)	(0.008)	(0.003)
Years of Age Squared	0.000***	0.000***	0.000***	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Female [0,1]	0.000	0.000	0.000	0.000	0.000
	(.)	(.)	(.)	(.)	(.)
Higher Education [0,1]	0.001	0.001	0.000	0.005	0.002
	(0.005)	(0.007)	(0.006)	(0.008)	(0.006)
Married [0,1]	-0.008*	-0.005	-0.009*	-0.003	-0.008*
	(0.004)	(0.007)	(0.005)	(0.011)	(0.005)
Employed [0,1]	0.003	0.005	0.002	0.010*	-0.003
	(0.003)	(0.005)	(0.004)	(0.006)	(0.010)
Log of Household Income	-0.000	0.001	-0.001	0.002	-0.005**
	(0.002)	(0.003)	(0.002)	(0.003)	(0.002)
Drinker	0.004	-0.000	0.007**	-0.001	0.003
	(0.002)	(0.004)	(0.003)	(0.006)	(0.003)
Conditions:					
Type-2 Diabetes [0,1]	-0.011**	-0.012*	-0.008	0.004	-0.011**
	(0.005)	(0.007)	(0.007)	(0.011)	(0.005)
Hypertension [0,1]	-0.005**	-0.006	-0.004	-0.012**	-0.003
	(0.003)	(0.004)	(0.003)	(0.006)	(0.003)

Region Fixed Effects	✓	✓	✓	✓	✓
Year Fixed Effects	✓	✓	✓	✓	✓
Individual Fixed Effects	✓	✓	✓	✓	✓
Observations	60160	26508	33652	18871	39572

Source: English Longitudinal Study of Ageing (ELSA), Wave 1-10.

Notes: The table reports estimates of the effect of the COVID-19 pandemic on smoking behaviour. Specifically, Column (1) reports estimates for the full-sample. In Columns (2) and (3), I split the sample by gender, and in Columns (4) and (5) we split the sample by employment status. Results are conditional on region, time, and individual fixed effects. Robust standard errors in parenthesis. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Figure 1

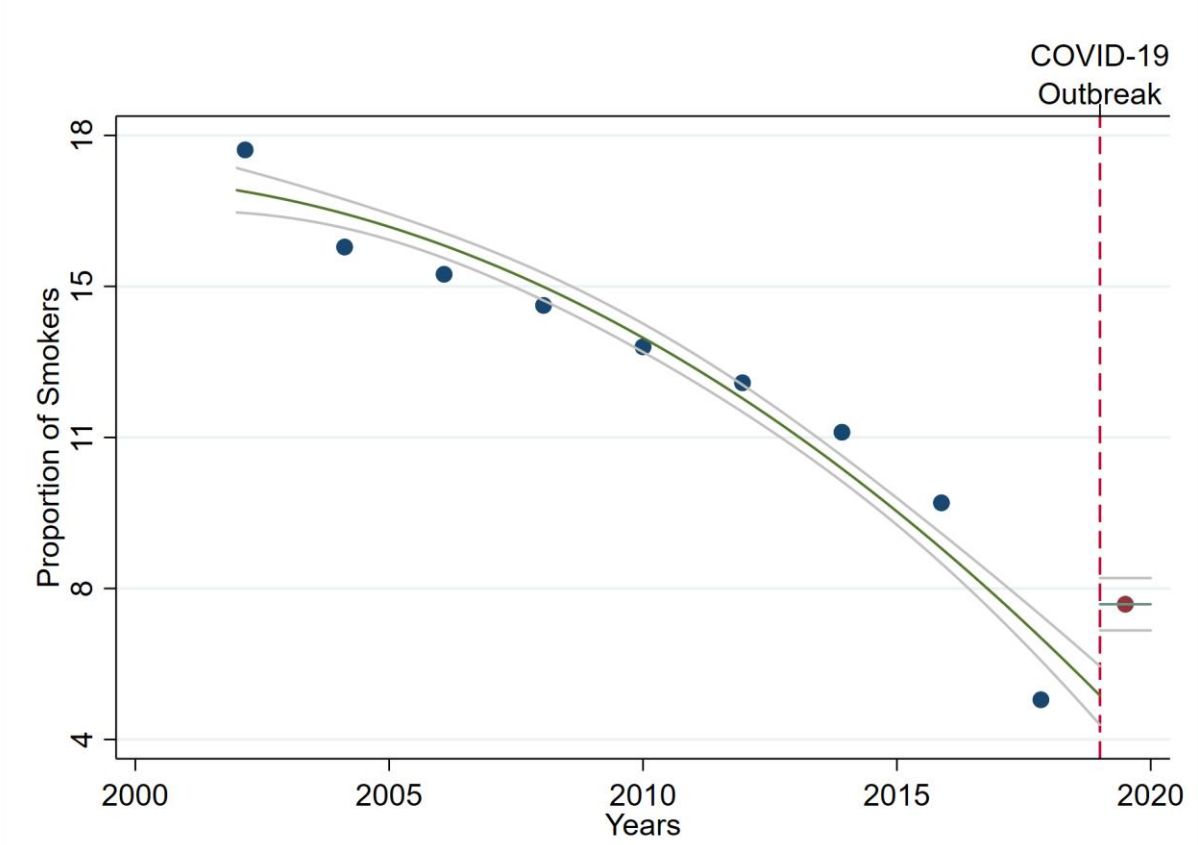

Figure 2